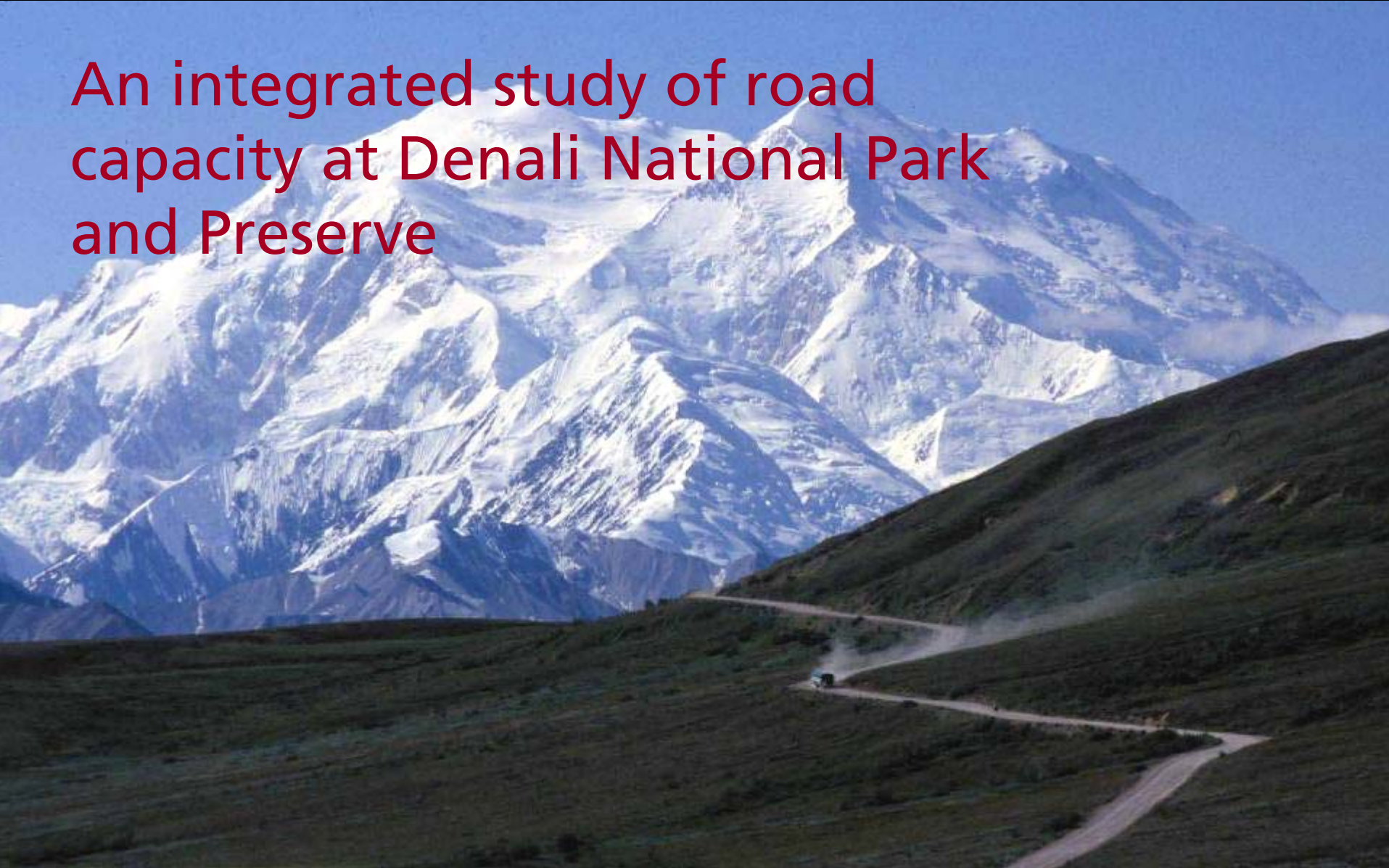




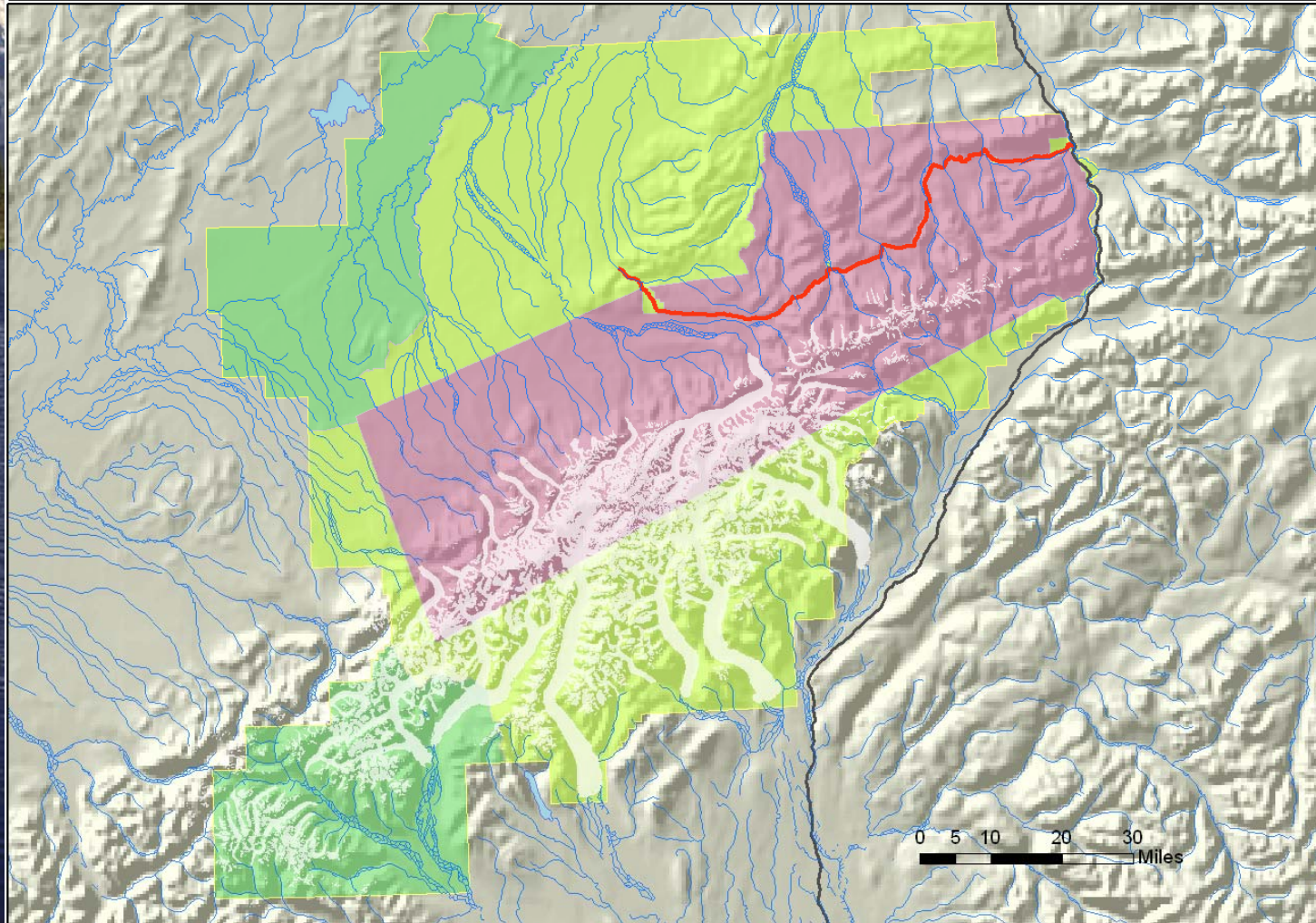
# An integrated study of road capacity at Denali National Park and Preserve



# Background

## Denali National Park and Preserve

Alaska Region  
National Park Service  
U. S. Department of the Interior



# Background

- In 1972, mandatory visitor transportation system (VTS) implemented
- General Management Plan authorized limit of 10,512 vehicle trips annually on park road in 1986
- Limit based on 1984 use levels allowing a 20% increase in buses and 45% decrease in private vehicles

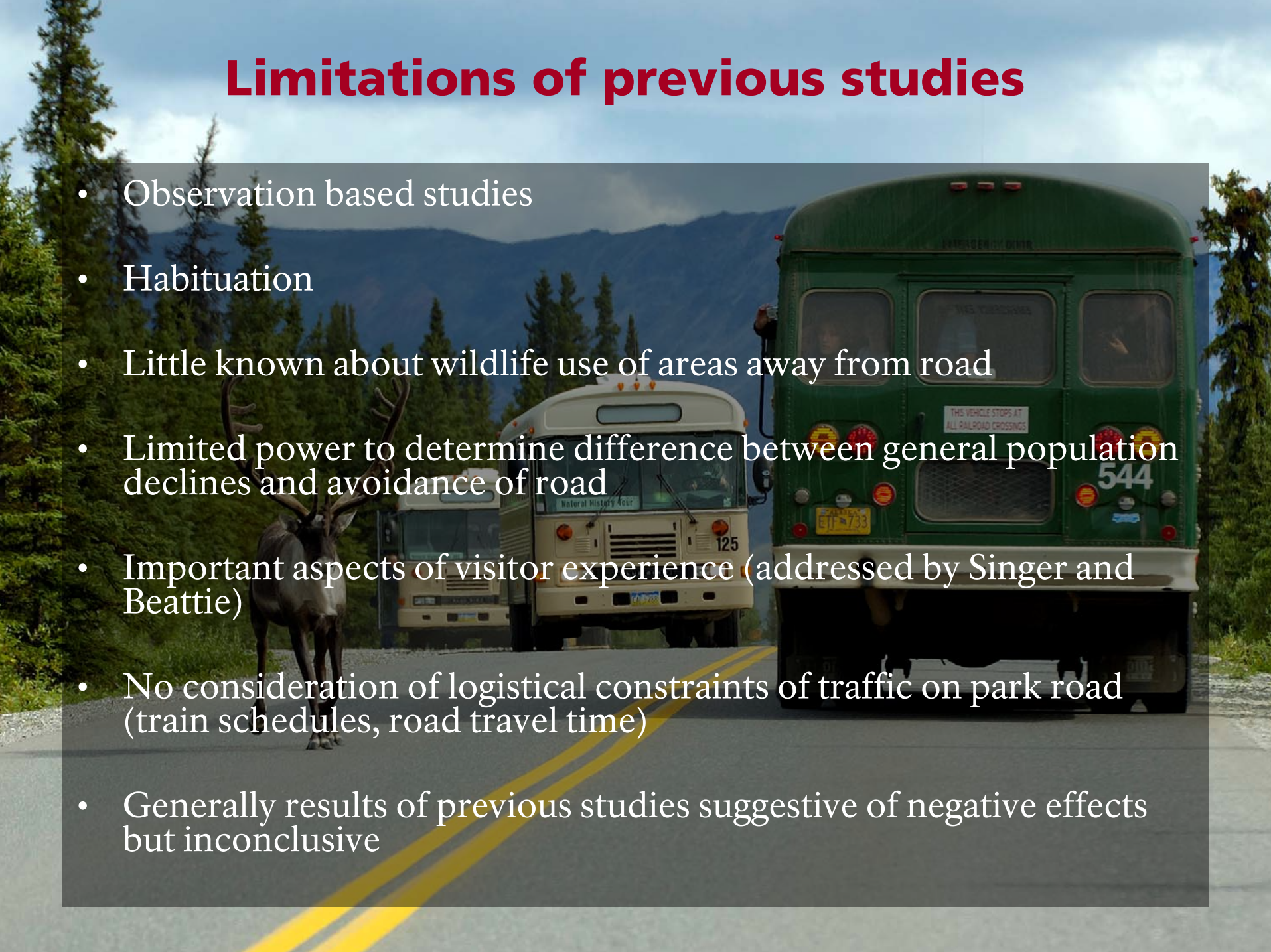
# Previous Park Road studies

- Noted negative reactions from some wildlife near road: Tracy 1977, Singer and Beattie 1986, Putera and Keay 1996
- Negative trend in wildlife numbers with traffic volume: Taylor et al. 1997
- No negative reactions or trends in wildlife detected: Burson et al. 2000
- Visitors generally satisfied with park road experience: Singer and Beattie 1986, Miller and Wright 1998



# Limitations of previous studies

- Observation based studies
- Habituation
- Little known about wildlife use of areas away from road
- Limited power to determine difference between general population declines and avoidance of road
- Important aspects of visitor experience (addressed by Singer and Beattie)
- No consideration of logistical constraints of traffic on park road (train schedules, road travel time)
- Generally results of previous studies suggestive of negative effects but inconclusive

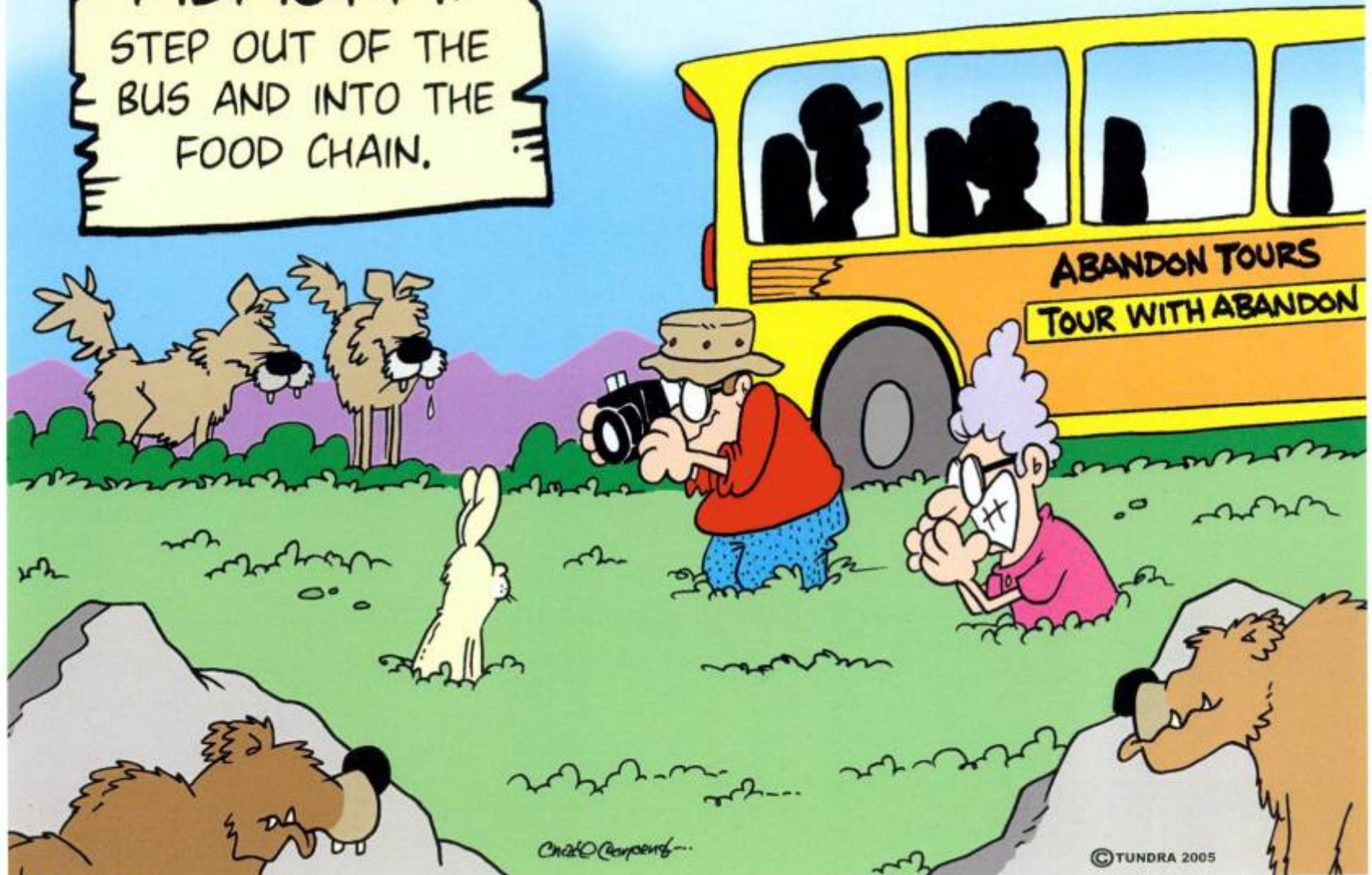


# Background

- Pressure to increase access to Denali Park from various interest groups
- NPS designed this study to determine carrying capacity of park road to be able to evaluate limits set on traffic
- Road capacity study will determine whether the park road is currently at-, under- or over-capacity

ALASKA:

STEP OUT OF THE  
BUS AND INTO THE  
FOOD CHAIN.



Chad Carpenter

# Road capacity study



- Logistical constraints/traffic movement
  - Analysis of movements of buses and other vehicles on road and constraints associated with road design and traffic flow



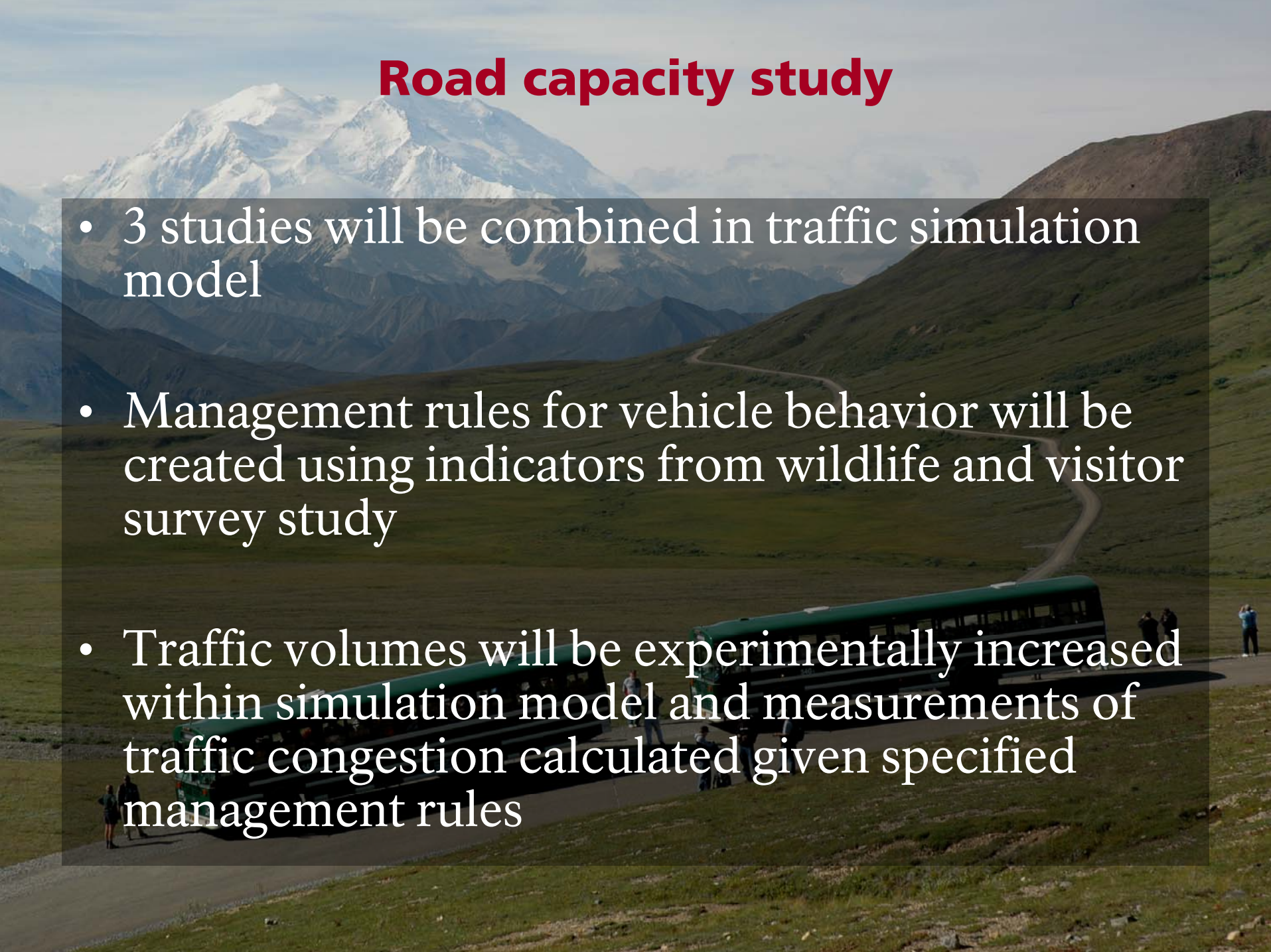
- Wildlife movement
  - Analysis of spatial and temporal movements of 20 grizzly bears and 20 Dall's sheep in relation to the park road



- Visitor experience
  - Surveys to determine what defines a quality experience on the Denali Park Road

# Road capacity study

- 3 studies will be combined in traffic simulation model
- Management rules for vehicle behavior will be created using indicators from wildlife and visitor survey study
- Traffic volumes will be experimentally increased within simulation model and measurements of traffic congestion calculated given specified management rules



# Road capacity study

Today's talk:

- General study design
- Preliminary results from 2006 work
- Potential traffic management strategies suggested by results for use in simulation models
- Future work



# Methods: traffic model



Enter reason for stop.

WILDLIF ☐ OFF

TRAFFIC

STOP

REST

CONSTR

OTHER

005

-002

SUBMIT CANCEL

Enter how many passengers picked-up or dropped-off?

Location of touch screen panel in bus

Enter animal species observed.

BEAR CARIB

DALL SH MOOSE

WOLF OTHER

MOOSE

OK/PLT CANCEL

Enter the relative location of animal sighted.

SUBMIT REDO CANCEL

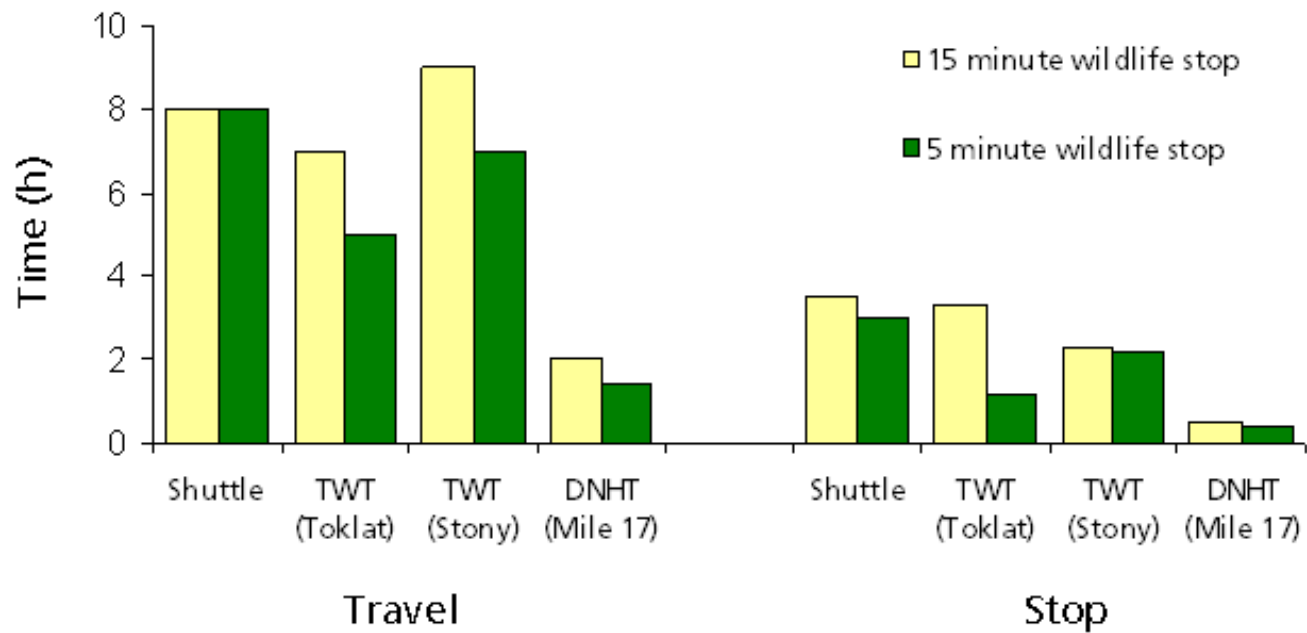
- GPS units installed on ~85 buses and ~33 NPS vehicles
- 20 SLCD data logging panels in buses
- Base stations automatically download data throughout park
- Hand-held GPS units passed out at Savage check station

# Methods: traffic model



- Traffic counters installed along park road measure hourly traffic levels
- Probability of wildlife encounters will be created using SLCD data
- Real data will be analyzed to simulate patterns of traffic behavior on the Park Road
- Cooperators: Ted Morris, Max Donath and John Hourdos, U. of Minnesota, Minnesota Traffic Observatory

# Methods: traffic model



# Methods: wildlife

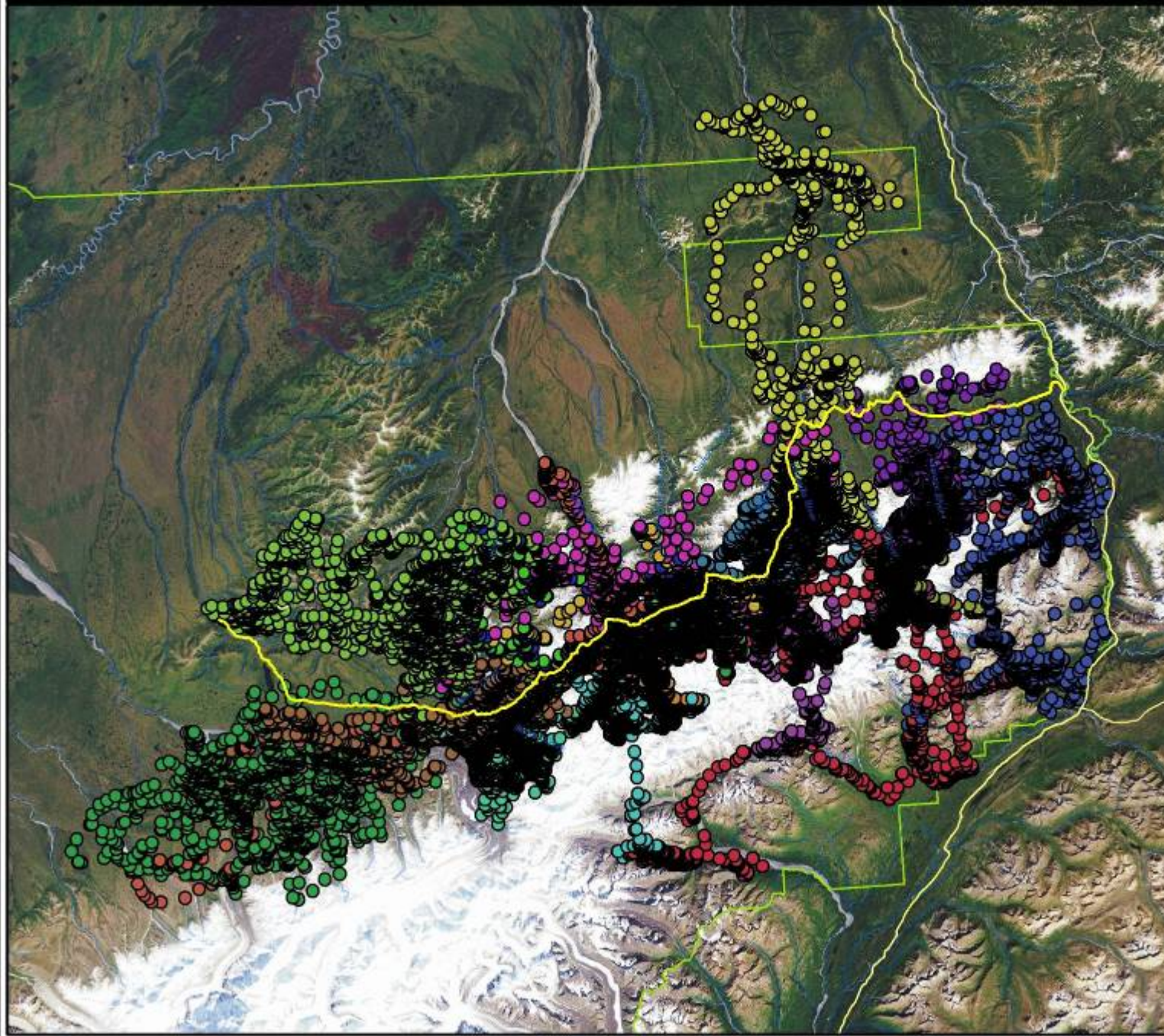


- 20 grizzly bears captured and fitted with GPS collars in Spring 2006
- GPS collars record hourly locations of individuals throughout summer
- Spatial analysis of habitat use and movements
- Cooperators: Rick Mace, Montana Department of Fish, Wildlife and Parks, University of Montana

# 2006 Grizzly Bear Locations

Denali National Park Road Capacity Study

Alaska Region  
National Park Service  
U. S. Department of the Interior



## Legend

- Denali Park Road
- Denali Highway
- Parks Highway
- Rivers
- Denali National Park Boundary

## Bear Locations 2006

### id, sex

- 574573, F
- 574574, M
- 574575, M
- 574576, F
- 574577, F
- 574578, F
- 574580, F
- 574581, F
- 574582, F
- 574583, F
- 574584, F
- 574585, F
- 574586, F
- 574587, M
- 574588, F
- 574589, M
- 574590, F
- 574591, M
- 574592, M



National Park Service  
DNA Wildlife

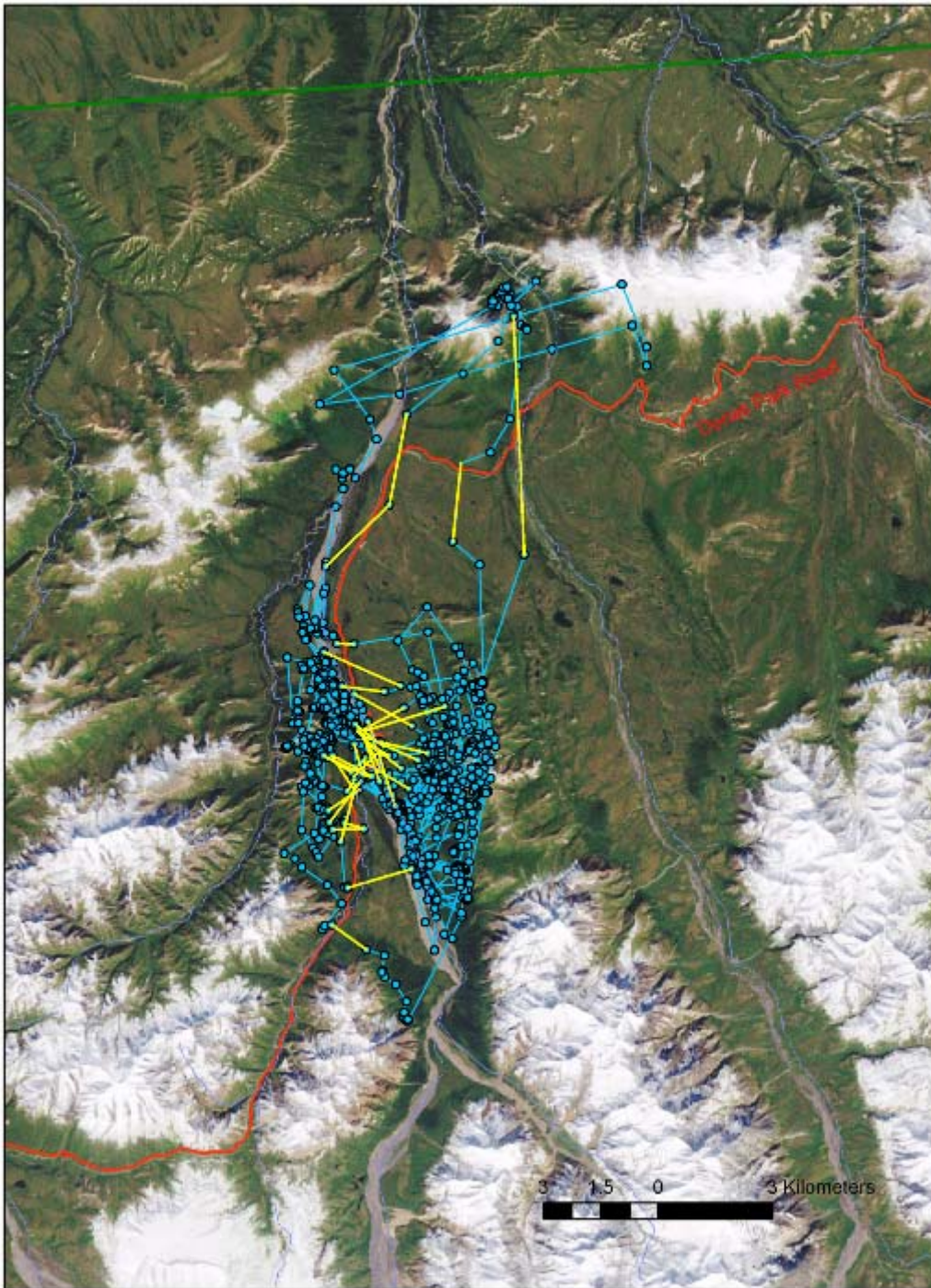


8 4 0 8 Miles



Movement paths and  
locations of bear # F573  
within 3km of the road

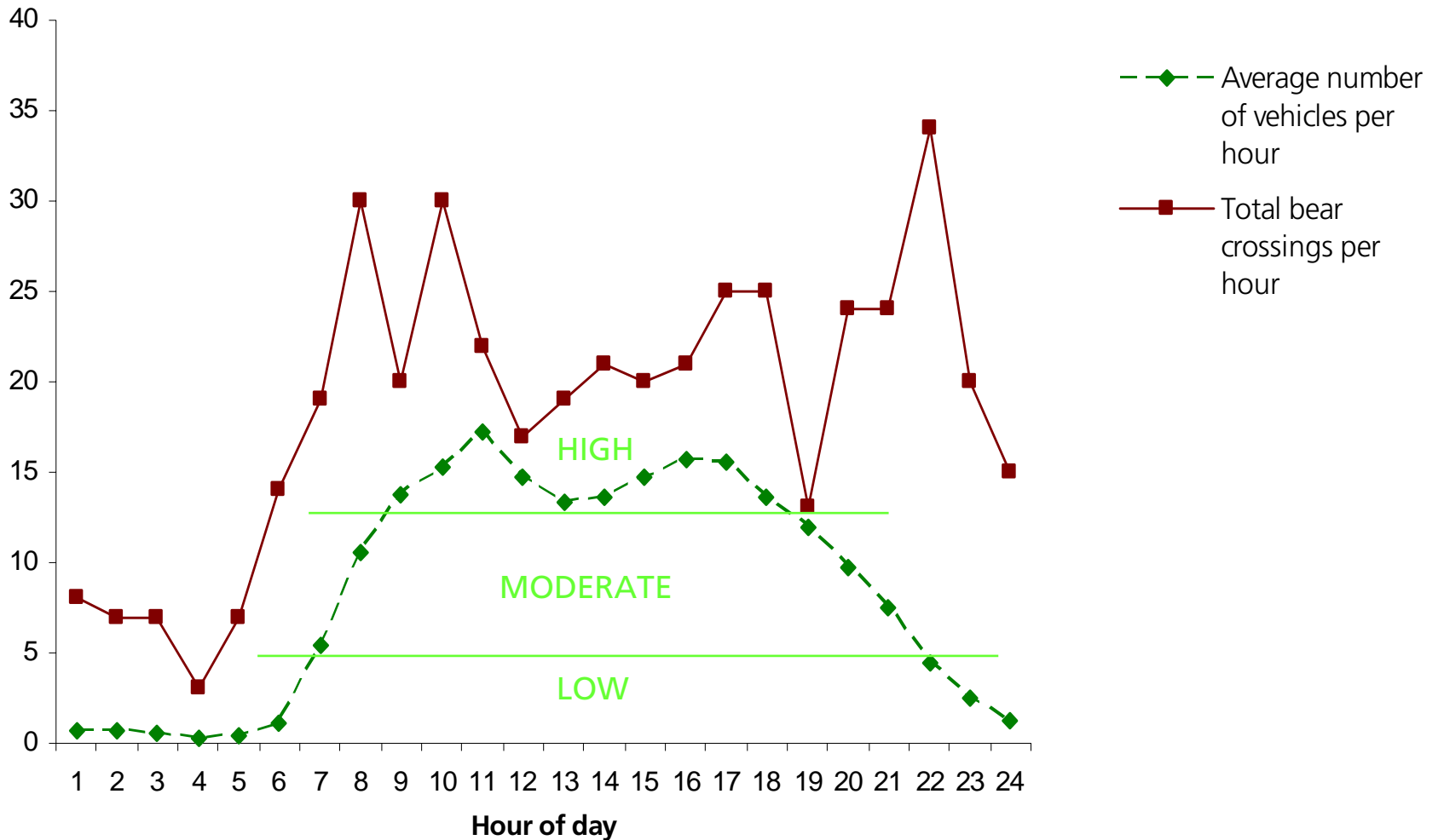
Movement paths that  
cross the Denali Park  
Road are in yellow



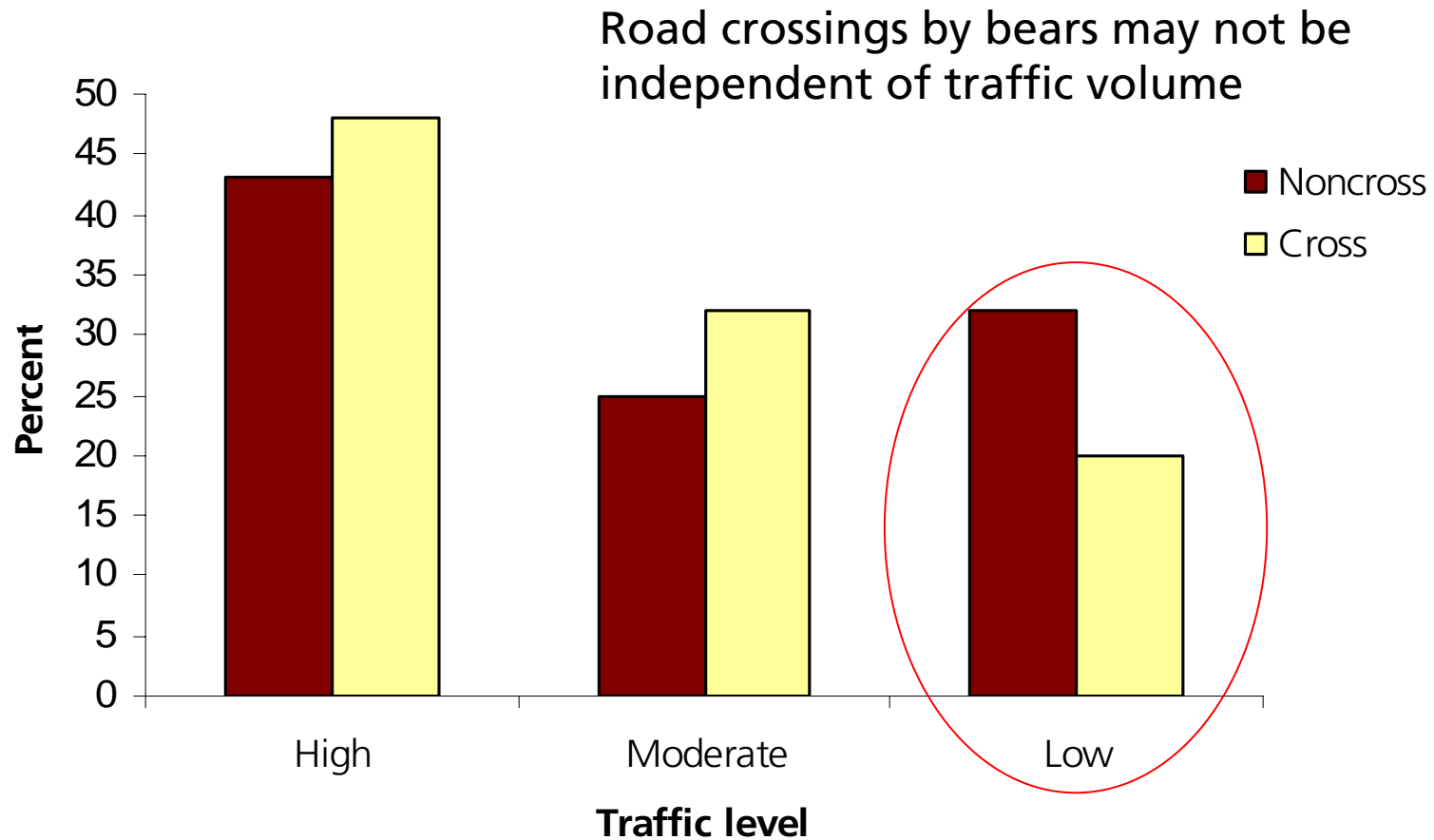


	Number of road crossings per month					
Bear ID	May	June	July	Aug	Sept	Total
F573	2	10	16	7	3	38
F576	0	0	0	0	0	0
F577	0	0	0	0	0	0
F578	10	0	0	0	0	10
F580	0	4	0	0	0	4
F581	8	13	8	26	4	59
F582	3	17	7	19	19	65
F584	33	43	17	39	12	144
F585	0	0	0	0	0	0
F586	3	6	4	21	8	42
M587	15	11	2	0	n/a	28
F588	1	0	2	1	0	4
M589	0	0	0	0	0	0
F590	14	20	11	6	11	62
M591	6	4	0	0	0	10
M592	0	0	0	0	0	0
Total	95	128	67	119	57	466
% of total crossings	20.3	27.5	14.4	26.0	12.0	

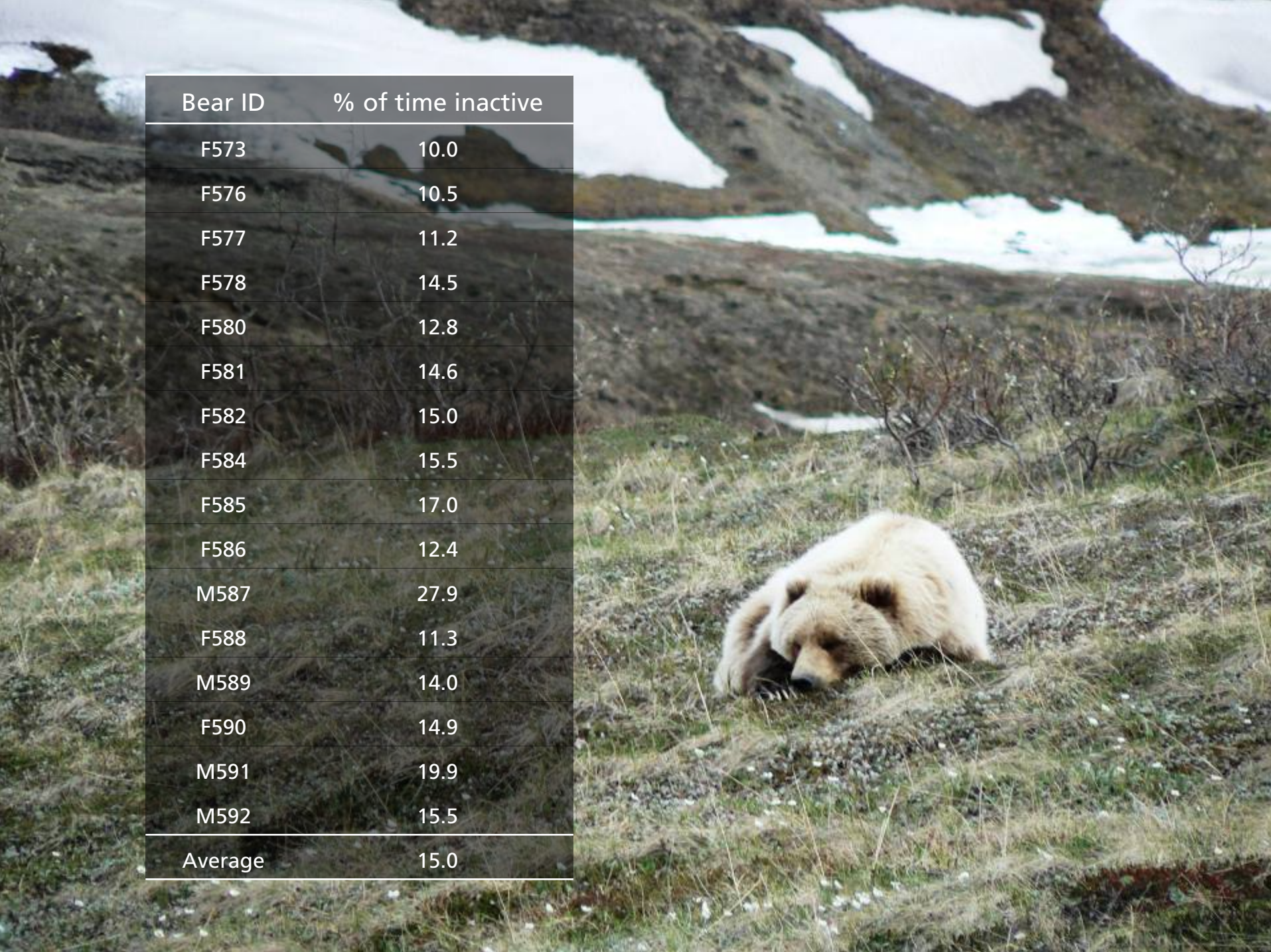
# Preliminary results: wildlife



# Preliminary results: wildlife



Chi Squared = 33.9,  $P < 0.001$



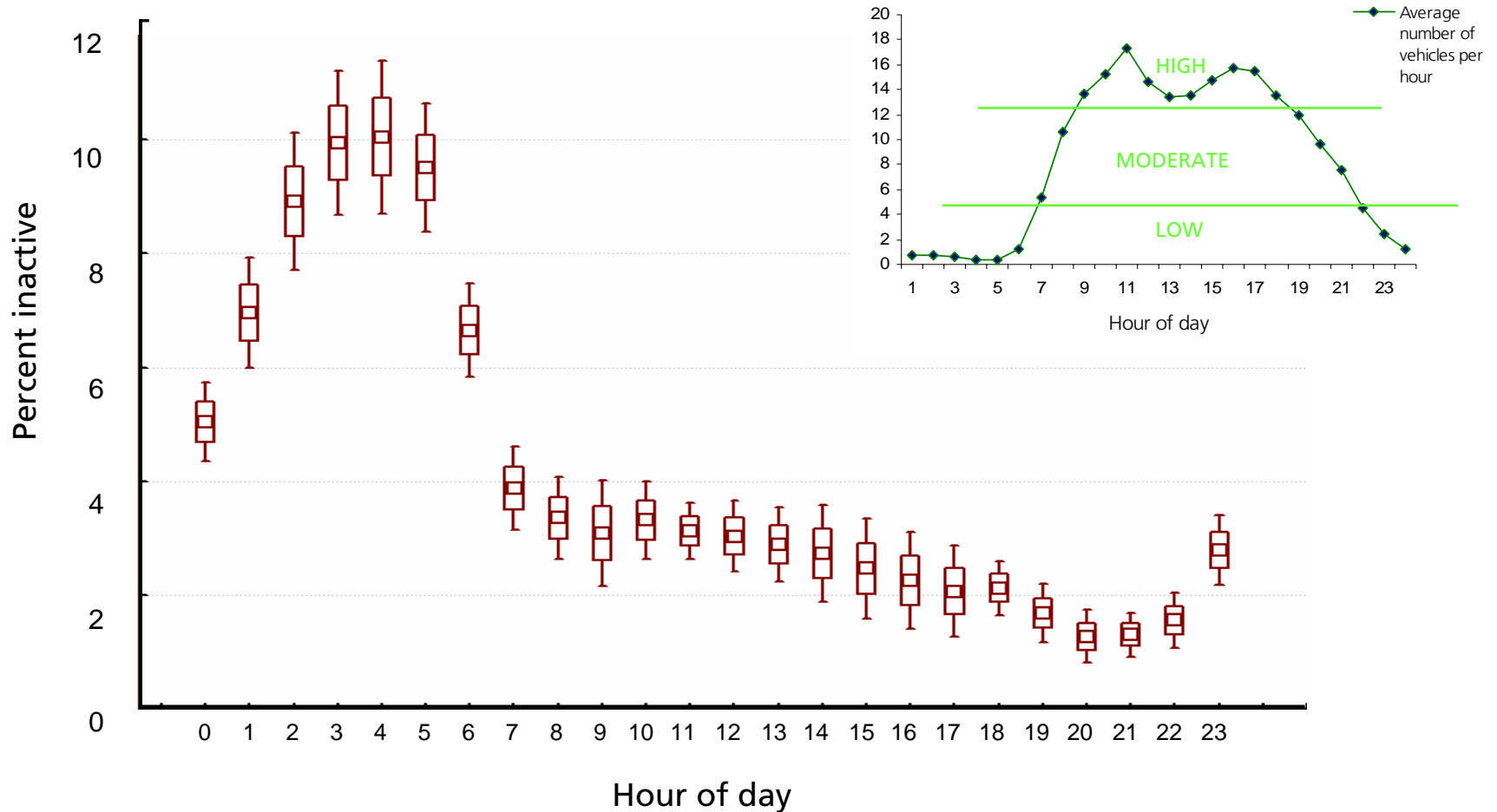
A photograph of a brown bear resting on a grassy hillside. The bear is lying down, facing away from the camera, with its head tucked down. The background shows a rugged, mountainous landscape with patches of snow and sparse vegetation. The table is overlaid on the left side of the image.

Bear ID	% of time inactive
F573	10.0
F576	10.5
F577	11.2
F578	14.5
F580	12.8
F581	14.6
F582	15.0
F584	15.5
F585	17.0
F586	12.4
M587	27.9
F588	11.3
M589	14.0
F590	14.9
M591	19.9
M592	15.5
Average	15.0

# Preliminary results: wildlife



Probability of a bear being inactive  
by hour





## Movement paths and locations of bear # F573

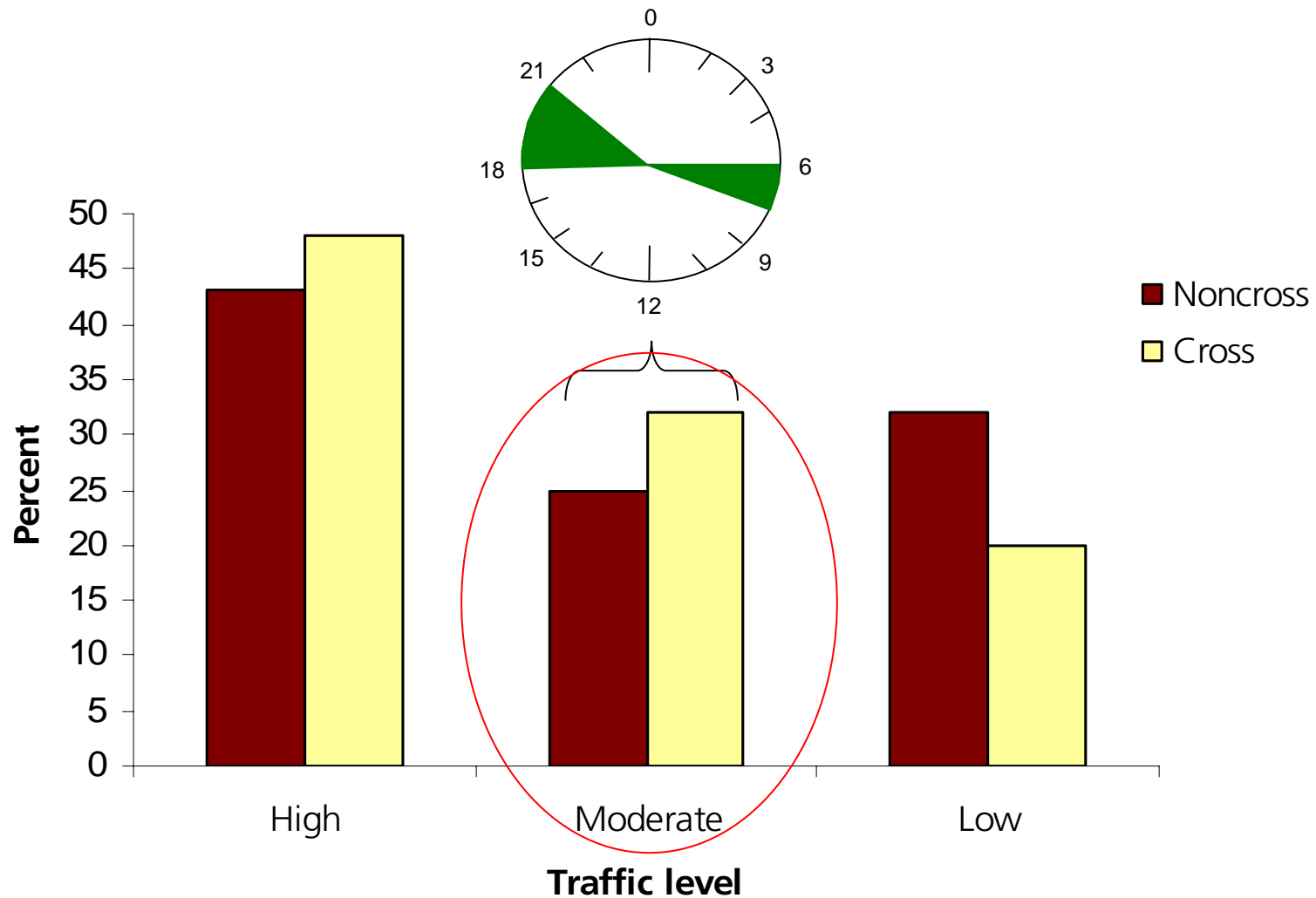
### General habitat use for inactive points

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	Mountain	Tundra	River channel
<hr/>			
Random points	53	90	4
Bear 573 points	128	9	10

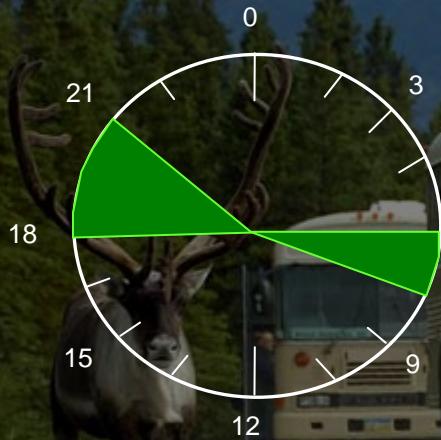
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# Preliminary results: wildlife



# Potential mgmt: wildlife

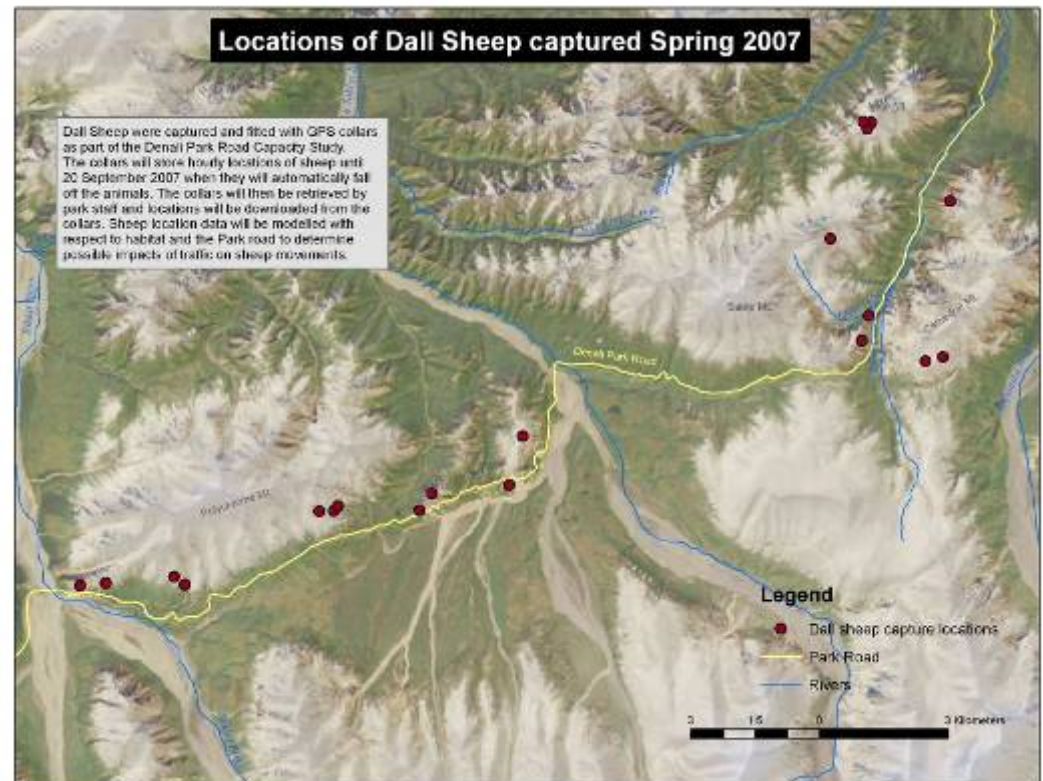
- Additional vehicles will not increase traffic volume during these time periods



- Vehicle schedules will be staggered on the Park Road to allow more space between vehicles during these time periods

# 2007: wildlife

- Continuing analysis of Grizzly bear data
- 20 Dall's sheep captured March 2007
- Dall's sheep behavioral observations



# Methods: visitors



- >120 qualitative visitor surveys conducted summer 2006 about visitor experience on the Park Road
- Qualitative visitor surveys were analyzed for recurring themes which will be used to create indicators and 2007 quantitative survey
- Recurring themes ranked by frequency of occurrence in interviews. Relative index of importance.
- Cooperators: Robert Manning and Jeff Hallo, University of Vermont

# Preliminary results: visitors



“What are the three things you enjoyed most about your time on the Denali Park Road today?”

Code	Frequency
Wildlife	87
Scenery/mountains	83
Driver/information provided by the bus driver	49
Mt. McKinley/Denali	14
Natural environment/landscape	8
Social experience with others	7
Solitude/not too much traffic on the road	6
Bus transportation	4
Hiking	3
Ride along the road	3
Wildflowers	2
Polychrome Pass	2
Driving on the road with RV	2
Rules on the bus intended to protect wildlife	1
Being able to get off the bus and walk around	1

# Preliminary results: visitors



“What are the three things you enjoyed least about your time on the Denali Park Road today?”

Code	Frequency
Long ride/being on the bus	28
Nothing	20
Uncomfortable seats on the bus	19
Didn't see enough wildlife/wildlife too far away	12
Safety concerns (e.g., driving through Polychrome)	12
Dust	12
Condition of the road	10
Seeing buses/traffic	7
Frequency/duration of stops	6
Driver (e.g., couldn't hear, annoying, not informative)	5
Malfunctioning/dirty windows	4

# Preliminary results: visitors



“[If first time visitor]  
What did you expect  
your trip along the  
Denali Park Road to be  
like?”

Code	Frequency
More wildlife than was seen	34
Lots of wildlife to see	23
Long ride/many stops	21
Rough ride	16
Not sure what to expect	15
Scenic	15
Wild/undeveloped environment	12
Less wildlife than was seen	12
More traffic/use	4
Road is in better condition	3
More developed (e.g. paved road)	2
More than one road	1

# Preliminary results: visitors



“[If first time visitor] Was your trip better or worse than you expected?”

Code	Frequency
<i>Worse</i>	2
because less wildlife was seen than expected	11
because of the bus ride (e.g., bumpiness of ride, lack of stops, cold)	3
because scenery was not as great as expected	2
because of the driver	1
<i>Neither better nor worse than expected</i>	19
<i>Better</i>	18
because lots of wildlife was seen	18
because it is more beautiful/wonderful when seeing it in person	9
because of the information provided by driver	1
because it's not very crowded	1
because of nice facilities along the road	1

# Preliminary results: visitors



“What are the things that you’d need to see and do to say that you’ve had a great visit along the Denali Park Road?”

Code	Frequency
Wildlife	57
Grizzly bear	44
Denali/Mt. McKinley	37
Scenery/mountains	34
Moose	20
Wolf	17
Caribou	12
Tour information/learn about wildlife, history, geology	11
Sheep	9
Experience the vastness of the park	7
Get out of bus and walk	4
Golden eagle	4
Hiking	4

# Preliminary results: visitors



“Was there anything that detracted from your wildlife viewing experience along the Denali Park Road today?”

Code	Frequency
Nothing detracted from the wildlife viewing experience	49
Lack of wildlife or wildlife within close view	26
Windows (e.g., dirty malfunctioning, or poorly designed)	16
Behavior and actions of others on the bus (e.g., scaring wildlife, get in pictures, disobeying rules)	10
Number of people on the bus	7
Feeling rushed and not having enough time to take pictures or view wildlife	4
The number of buses	4
Comfort of bus	3
Signs of civilization among wildlife	2
Impact of buses on wildlife	2

# Preliminary results: visitors



“Did you experience any instances in which more than one bus was stopped to observe wildlife? [If yes] Did this affect the quality of your experience in any way?”

Code	Frequency
<i>Yes, positively</i>	
Other buses indicated that wildlife was present	25
<i>Yes, negatively</i>	
Multiple buses reduced enjoyment because it does not feel like wilderness	10
Multiple buses reduced enjoyment because it delays travel	7
Multiple buses at wildlife stops interfered with wildlife viewing	7
Multiple buses makes it feel crowded	5
<i>Yes, but it didn't impact the experience</i>	67

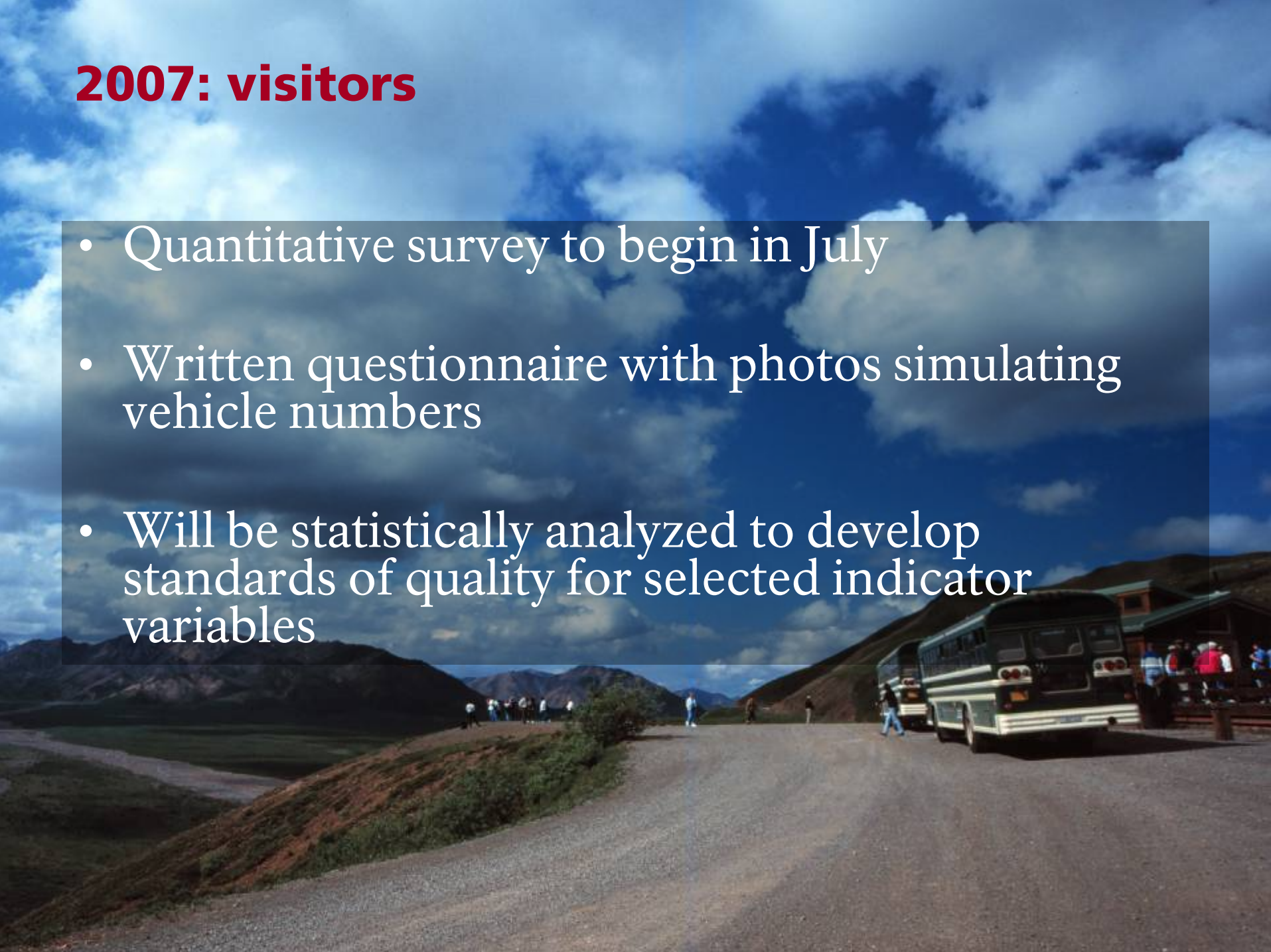
# Potential mgmt: visitors

- Only  $x$  number of buses are allowed at a wildlife stop at any one time
  - Acceptable numbers to be determined using interview questions and photos
- Buses may only spend 10 minutes at a wildlife stop

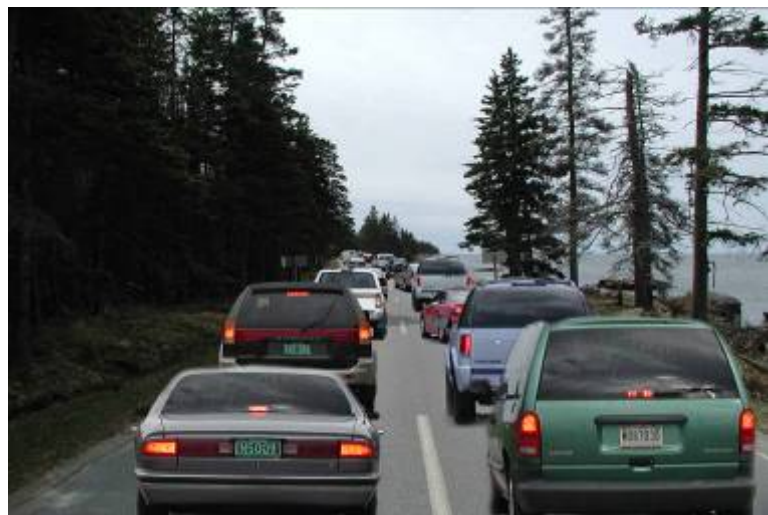


## 2007: visitors

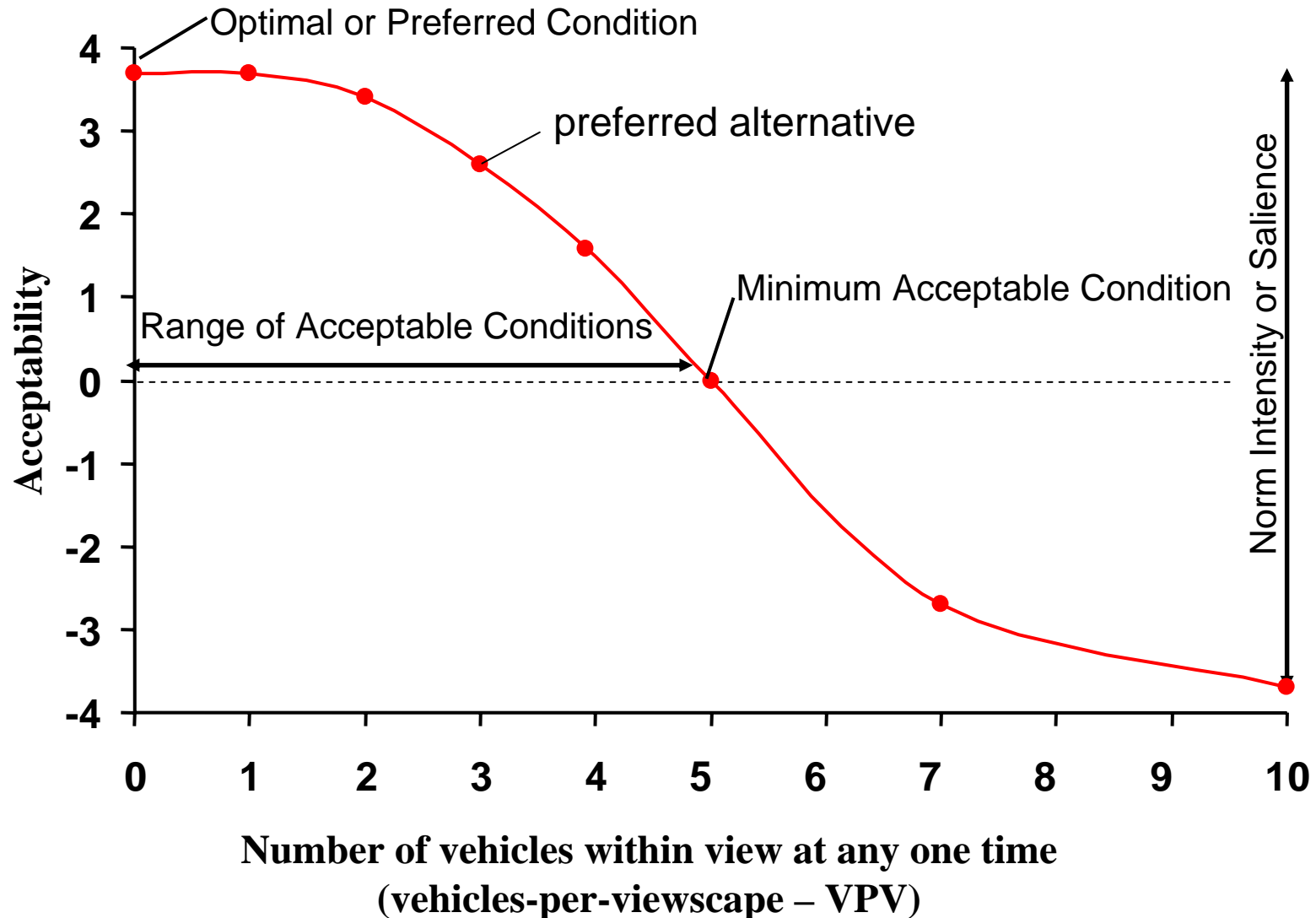
- Quantitative survey to begin in July
- Written questionnaire with photos simulating vehicle numbers
- Will be statistically analyzed to develop standards of quality for selected indicator variables



# Photo simulation: Acadia National Park



# Social norm curve (Manning et al. 1996)



# Photo simulation: Denali National Park

- Rest areas
- Wildlife stops
- Viewscape




# Study design: potential for 3 phases

- Park Road Capacity Study (2006-2008)
  - Determine whether road is currently at, under, or over capacity
- Depending upon result of road capacity study, conduct EIS to establish alternatives for increased road use (2007-2008)
  - Any increased traffic would be implemented over numerous years and alternate time periods
- Before-After-Control-Impact (BACI)
  - Study would be implemented to evaluate any negative effects of experimental traffic increase (2008-2010)
  - May include studies on traffic flow, animal movements, wildlife sightings, dust, noise, visitor experience

# Acknowledgements

- NPS road study personnel: Philip Hooge, Tom Meier, Pat Owen, Carol McIntyre, Amanda Peacock, Laura Phillips, Bridget Borg, Christine Himes
- NPS: Grady Wilson, Michael Thornton and rest of IT staff; Joe Van Horn; Bill Friesen, Craig Brandt, Jeff Wysong, and extended Auto Shop staff; Brad Ebel; Jon Paynter; Joe Durrenburger; Christopher Infante, Clare Curtis and staff of the Savage check station; Phyllis Motsko and Concessions staff; Tim Taylor; John Burch; Jim Lawler; Charlie Loeb; Andrea Blakesley; Lucy Tyrrell, Carl Roland
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- Camp Denali: Simon Hamm
- University of Vermont: Robert Manning, Jeff Hallo
- University of Minnesota: Ted Morris, Max Donath, John Hourdos, Jerrilyn Thompson
- Montana Department of Fish, Wildlife, and Parks; University of Montana: Rick Mace



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Visit the Denali Park Road capacity study website at:  
<http://www.nps.gov/dena/naturescience/denali-park-road-capacity-study.htm>

Or Google: Denali Park Road capacity